ORIGINAL CONTRIBUTION

Breast Cancer Trends of Black Women Compared With White Women

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Objective: To investigate why breast cancer mortality rates have decreased in the 1990s for white women but not for black women.

Design: Racial differences in breast cancer incidence, survival, and mortality rates were examined using regression methods and age-period-cohort models.

Setting: United States breast cancer mortality rates from 1970 through 1995, breast cancer incidence rates from 1980 through 1995, and 3-year survival rates from 1980 through 1993. The incidence and survival data are from the Surveillance, Epidemiology, and End Results Program, representing 11% of the US population, of the National Cancer Institute, Bethesda, Md.

Results: For both white and black women aged 30 to 39 years, breast cancer mortality rates began decreasing in 1987. For white women aged 40 to 79 years, breast cancer mortality rates declined after 1989, and for black women aged 40 to 69 years, mortality rates ceased increasing in the middle to late 1980s. Birth cohort trends were similar by race, but calendar period trends and survival rates differed.

Conclusions: Declines in mortality rates in women younger than 40 years reflect a favorable birth cohort trend for women born after 1948 and likely reflect changes in risk factors. The increased early detection of breast cancer by mammography and improvements in breast cancer treatment appear to be contributing to the improving mortality trends in older women, although black women appear to have benefited less than white women from early detection and treatment advances. In addition, substantial increases in survival rates for white women with regional disease have contributed to their declining mortality rates and likely reflect an increasing use of beneficial adjuvant therapy.

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MANY IMPORTANT medical advances for the management of breast cancer have occurred in the past 20 years. In the area of early detection, the use of mammography increased sharply[1] beginning in the early 1980s. In the area of treatment, the benefits of adjuvant therapy, in particular chemotherapy for premenopausal women and tamoxifen citrate for postmenopausal women, have been shown in clinical trials.[2-4] If these medical interventions have benefited the general population, their effects should be reflected in cancer statistics. The efficacy of early detection should be evidenced by reductions in the incidence rates of late-stage disease, treatment advances should be reflected in increasing survival rates, and their overall effects should result in declines in breast cancer mortality rates.[5]

Breast cancer mortality rates for white women aged 30 to 79 years have reportedly[6,7] been declining since 1990. In contrast, breast cancer mortality rates for black women have not been declining recently.[7,8] In this article, we analyze black and white incidence, survival, and mortality rates by age, particularly with age-period-cohort models, to examine and understand these recent trends.

RESULTS

The age-adjusted US breast cancer mortality rates for white and black women for 1970 through 1995 are shown in **Figure 1**. Breast cancer mortality rates by race and decades of age beginning at age 30 years are displayed in **Figure 2**. The slopes of mortality rate trends from 1980 through 1995 for black and white women that were determined by piecewise regression analyses are reported in **Table 1** and displayed in Figure 2.

The age-adjusted breast cancer mortality trends for black women (Figure 1)

METHODS

DATA SOURCES AND DESCRIPTIONS

Incidence and survival rates were obtained from population-based data collected by the Surveillance, Epidemiology, and End Results Program (SEER) of the National Cancer Institute, Bethesda, Md. The data consisted of cases of breast cancer diagnosed in white and black women from 1973 through 1995 among residents of 9 geographic areas, termed the SEER areas: Connecticut; Hawaii; Iowa; New Mexico; Utah; Atlanta, Ga; Detroit, Mich; the Seattle–Puget Sound area, Wash; and the San Francisco–Oakland area, Calif.[9] Incidence and survival rates are for primary breast cancers, excluding cases diagnosed only at autopsy or recorded only on death certificates. The annual incidence rates are age-adjusted to the 1970 US population by direct standardization.[10] Three-year relative survival rates by tumor extent at diagnosis are examined for the diagnostic years 1980 through 1993.[11,12]

Categories of tumor extent at diagnosis used in this report were in situ, localized, regional, and distant diseases. The overall incidence rates were for the total number of invasive cancers, including unstaged cancers but excluding in situ lesions. The general descriptions of each stage at diagnosis were as follows: in situ lesions are those that have not penetrated the basement membrane; localized disease, an invasive neoplasm confined entirely to the breast; regional disease, a neoplasm that has extended beyond the limits of the breast directly into surrounding organs, tissues, or regional lymph nodes; distant disease, a neoplasm that has spread to remote sites of the body; and unstaged disease, cancers for which insufficient information was available to permit accurate assignment of a stage.

The breast cancer mortality rates are from data collected by the National Center for Health Statistics, Hyattsville, Md, which receives death certificates from the states and compiles mortality data by race, sex, age, and year and cause of death. For the present study, only white and black women in the United States who were reported to have an underlying cause of death of breast cancer between 1970 and 1995 were included. We used the *International Classification of Diseases, Ninth Revision, Clinical Modification,*[13] to classify female breast cancer deaths as code 174. The mortality rates are age-adjusted to the 1970 US population by direct standardization.[10]

The age groups used for the incidence and mortality data included all ages, 30 to 39 years, 40 to 49 years, 50 to 59 years, 60 to 69 years, 70 to 79 years, and 80 years and older. Because survival by stage at diagnosis and decades of age yield too few cases for accurate assessments of survival rates, we present the stage-specific survival rates by all ages, younger than 50 years, aged 50 to 64 years, and aged 65 years and older.

STATISTICAL ANALYSIS

Standard regression analyses[14] of log-transformed rates were used to determine the slopes of the trends of the rates. Each such slope can be interpreted as indicating the annual percentage change of the rates. Statistical tests of slopes are based on *t* tests, with 2-sided *P* values reported. Piecewise regression analysis[15] was used to determine any changes in slope for US breast cancer mortality trends occurring after 1982.

Age-period-cohort models were fit to the breast cancer mortality data using 2-year age and calendar period intervals.[16] Thirty age intervals were used, ranging from 24 to 25 years of age to 82 to 83 years of age. Thirteen calendar period intervals were used, ranging from 1970 to 1971 to 1994 to 1995. Forty-two 4-year birth cohort intervals were used, ranging from 1886 to 1889 to 1967 to 1970. Each birth cohort will be referred to in this article by the second year in the interval. For example, the 1950 birth cohort will refer to women born between 1949 and 1952, with 75% of women in this cohort having been born in 1950 and 1951. Changes in the slope of long-term linear trends in birth cohort and calendar period effects were examined using identifiable differences in linear contrasts.[17] A significant change in the birth cohort trend often indicates changes in an etiologic factor that result in increasing or decreasing risk—eg, changes in fertility and reproductive patterns. A significant change in the calendar period trend often indicates the effects of newly introduced or improved medical interventions, such as early detection procedures and new treatments, or a change in the ascertainment or coding of the cause of death. Standard errors of the linear contrasts were adjusted for possible overdispersion when the deviance for the full age-period-cohort fit exceeded the number of residual degrees of freedom.[18]

increased in the 1980s and then leveled off after 1988. The age-adjusted breast cancer mortality rates for white women increased in the 1980s, although not to the same extent as for black women, and then declined after 1989. Age-specific rates show additional patterns for each race (Figure 2, Table 1). For black women aged 70 years and older, rates increased at a constant pace in the 1980s and 1990s. For black women aged 40 to 69 years, cancer mortality trends show increases until the mid to late 1980s, when mortality trends moderated, with significant decreases in slope. Despite the moderating trends, mortality rates for black women aged 40 to 69 years are not decreasing significantly in the 1990s, but rates have declined significantly since 1987 for black women aged 30 to 39 years.

With the exception of the youngest and oldest decades of age, age-specific breast cancer mortality patterns in white women differed from those in black women. For white women aged 80 years and older, mortality rates increased throughout the 1980s and 1990s, as they did for the oldest black women. For white women aged 60 to 79 years, breast cancer mortality rates increased significantly until the late 1980s, but subsequently there were significant declines, with greater declines in 60- to 69-year-old women than in 70- to 79-year-old women. For white women aged 40 to 59 years, rates declined in the 1980s, with even greater declines beginning in the 1990s. For white women aged 30 to 39 years, the rates were level until 1987 and declined significantly thereafter, as they did for black women in the same age group.

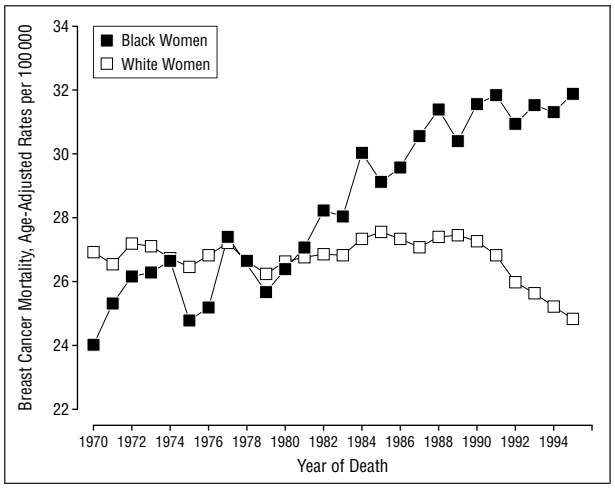

Figure 1. *United States breast cancer mortality by age, showing age-adjusted rates for US black women and white women.*

The results of age-period-cohort analyses are shown in **Figure 3**. The birth cohort effects were similar for white women and black women. The similarity in these effects indicates that differences between white and black mortality trends cannot be explained by different trends in breast cancer risk factors. In particular, the sharp decline in breast cancer mortality risk[19,20] reported earlier for white women born after 1948 is now also apparent for black women (Figure 3). The birth cohort slope for women born between 1933 and 1950 was compared with that for women born between 1951 and 1967 using a difference in linear contrasts, which yielded a value of -0.87 ± 0.74 (slope ± SE) ($P = .01$) for white women and -1.56 ± 1.14 ($P = .17$) for black women. Although the decrease is not significant for black women, it is of the same magnitude as the decrease for white women. Thus, it appears that the breast cancer risk has decreased in black baby boomers (born after 1948) almost to the same extent as in white baby boomers. The recent declines in breast cancer mortality rates for 30- to 39-year-old black and white women can be viewed as a manifestation of this birth cohort trend.

The calendar period effects are plotted in Figure 3 (right). The slopes were higher in the 1980s than in the 1970s for white and black women. Differences in linear contrasts when the slope from 1978 through 1985 is compared with that from 1972 through 1979 indicate significant increases for white women: 0.26 ± 0.04 ($P<.001$), and for black women: 0.59 ± 0.12 ($P<.001$), with a greater increase for black women. Thus, the calendar period curves for black women and white women diverged during a period of an increasing use of mammography to detect breast cancer, suggesting that the treatment of the earlier detected cancers was less effective in black women than in white women. In the 1990s, the calendar period slopes decreased for both white and black women. The difference in linear contrasts when the slope from 1988 through 1995 is compared with the slope from 1982 through 1989 shows significant decreases for white women: -0.33 ± 0.04 ($P<.001$), and for black women: -0.20 ± 0.10 ($P = .04$).

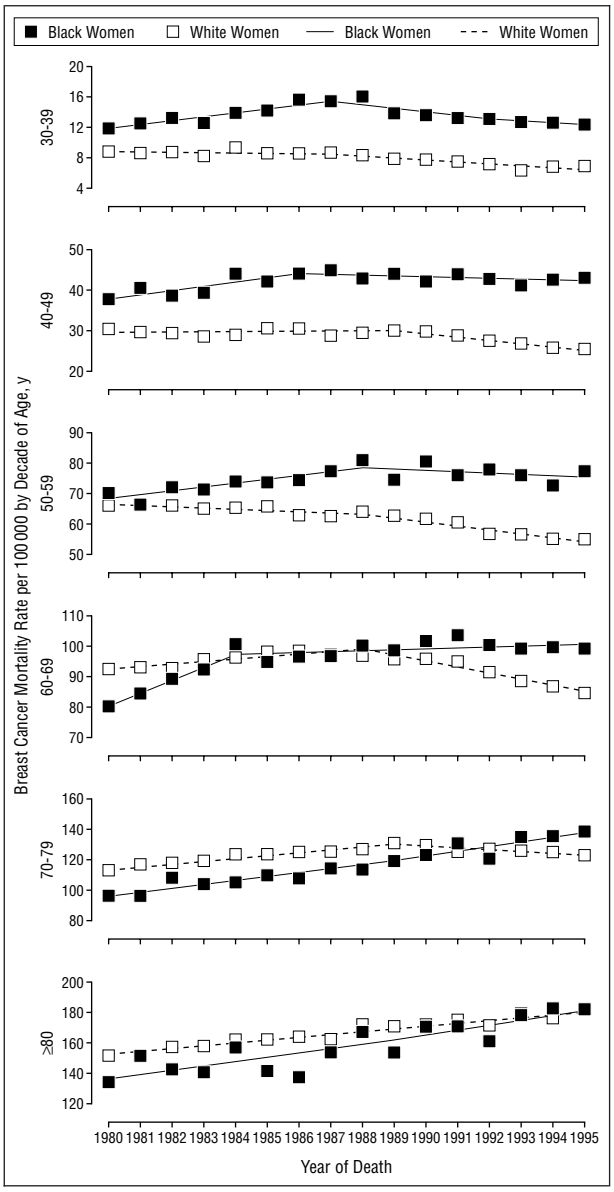

Figure 2. *Age-specific breast cancer mortality rates by decade of age and for black women and white women in the United States.*

The smaller decrease for black women suggests that although both black and white women benefited from recent advances, the effect was less in black women than in white women.

For white women aged 40 years and older, the declines in breast cancer mortality were preceded by declines in the incidence of regional disease and increases in regional disease survival.[6] In general, incidence rates declined in white women with regional disease beginning in the mid-1980s, a few years before the declines in breast cancer mortality. This is understandable because about 50% of breast cancer deaths occur in women diagnosed as having regional disease.[21] The annual percentage changes in the incidence rates of regional disease from 1985 through 1995 by race and age are reported in **Table 2**. The rates and their annual percentage changes are plotted in **Figure 4**. For white women, the incidence rates for regional disease declined significantly be-

Table 1. Annual Percentage Change (APC) in Breast Cancer Mortality Rates by Race and Age, 1980 Through 1995*

		Piecewise Regression Analyses		
Age Group, y	Race	APC From 1980 to Year of Change	Change in APC (Year of Change)	APC From Year of Change to 1995
30-39	B	3.60 ± 0.50†	−6.64 ± 0.84† (1987)	−3.04 ± 0.43†
	W	−0.44 ± 0.54	−3.11 ± 0.90‡ (1987)	−3.56 ± 0.46†
40-49	B	2.39 ± 0.43†	−2.82 ± 0.63† (1986)	−0.43 ± 0.27
	W	−0.06 ± 0.16	−3.17 ± 0.47† (1990)	−3.23 ± 0.36†
50-59	B	1.67 ± 0.33†	−2.22 ± 0.64‡ (1988)	−0.55 ± 0.39
	W	−0.76 ± 0.13†	−1.67 ± 0.30† (1989)	−2.43 ± 0.20†
60-69	B	4.71 ± 0.55†	−4.41 ± 0.66† (1984)	0.30 ± 0.17
	W	0.82 ± 0.14†	−2.95 ± 0.26† (1988)	−2.13 ± 0.16†
70-79	B	2.34 ± 0.18†	None	2.34 ± 0.18‡
	W	1.40 ± 0.10†	−2.29 ± 0.23† (1989)	−0.89 ± 0.16†
≥80	B	1.90 ± 0.30†	None	1.90 ± 0.30†
	W	1.07 ± 0.08†	None	1.07 ± 0.08†
All ages	B	1.91 ± 0.19†	−1.69 ± 0.37† (1988)	0.22 ± 0.22
	W	0.37 ± 0.07†	−2.17 ± 0.16† (1989)	−1.80 ± 0.11†

*Data are given as slope ± SE.
†P<.001.
‡P<.05.

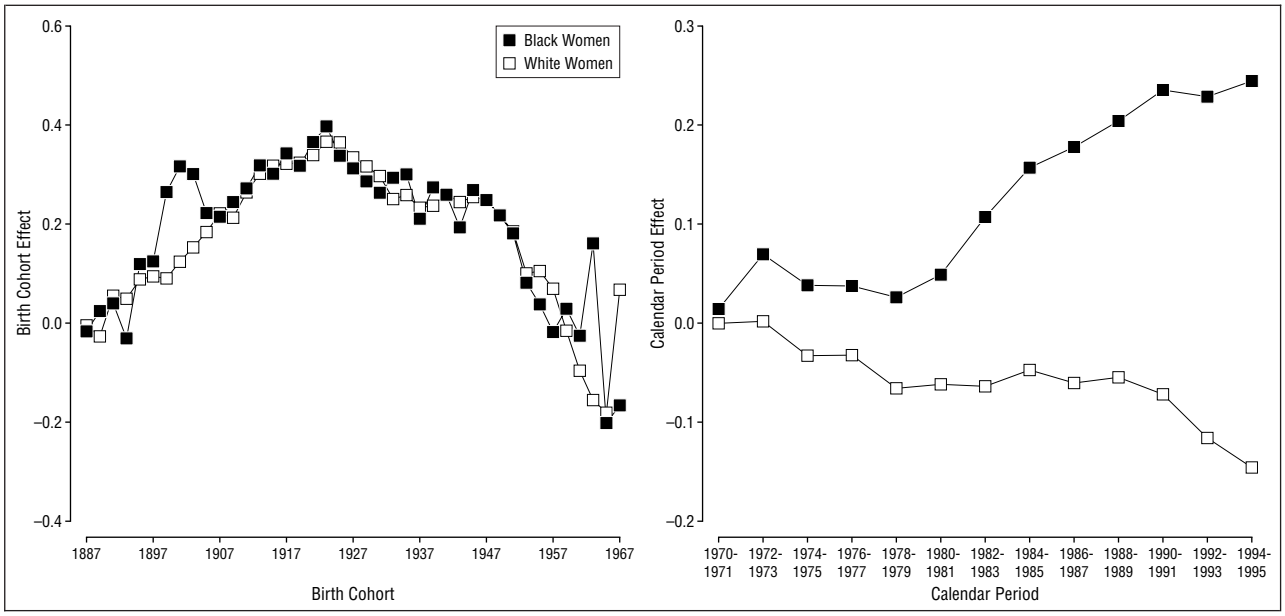

Figure 3. *Cohort effects (left) for years of birth 1887 through 1967 and period effects (right) for calendar period 1970 through 1995 in black women and white women in the United States.*

tween 1985 and 1995 for all ages and all age groups. For black women between 1985 and 1995, significant declines in regional disease rates were observed only for those aged 60 years and older.

Another factor that has been associated with declines in breast cancer mortality is increases in the survival rates of women with advanced-stage disease, attributable to the benefits of adjuvant therapy. Because survival by stage at diagnosis yields too few cases by decade of age for an accurate assessment of survival rates, we present the annual percentage change in survival rates for 1980 through 1995 by ages younger than 50 years, 50 to 64 years, and 65 years and older in **Table 3**. The 3-year relative survival rates for women with regional disease and their annual percentage changes by race and these age groups are displayed in **Figure 5**. For white women, significant increases in survival rates have occurred for all stages of disease, localized disease, and, more important, regional disease from 1980 through 1992 in all age groups (Table 3). In contrast, for black women significant increases have occurred in survival rates only for all stages of disease and for localized disease in women aged 50 years and older. Survival rates for black women with regional disease have not increased significantly, and the survival rates for regional disease increased more slowly in black women than in white women in every age group. Survival rates for white or black women with distant disease did not increase significantly for age-specific groups.

Table 2. Annual Percentage Change in Regional Disease Incidence Rates by Race and Age Group

Age Group, y	Race	Annual Percentage Change From 1985 to 1995*
30-39	B	−2.46 ± 1.44
	W	−2.35 ± 0.49†
40-49	B	0.58 ± 1.32
	W	−2.00 ± 0.31†
50-59	B	−0.19 ± 1.26
	W	−2.07 ± 0.41‡
60-69	B	−2.96 ± 0.70†
	W	−3.17 ± 0.24‡
70-79	B	−3.01 ± 1.32†
	W	−2.88 ± 0.42‡
≥80	B	−4.84 ± 2.01†
	W	−2.22 ± 0.48†
All ages	B	−1.43 ± 0.50†
	W	−2.47 ± 0.24‡

**Data are given as slope ± SE.*
†P<.05.
‡P<.001.

COMMENT

Three important recent changes have occurred in breast cancer mortality: for black and white women younger than 40 years, since the mid-1980s the mortality rates have declined; for white women aged 40 to 79 years, in the 1990s their rates have declined; and for black women aged 40 to 69 years, in the late 1980s the rates were moderate. Age-period-cohort analysis indicates that the declines in the mortality rates for black and white women aged 30 to 39 years reflect declining birth cohort effects for white and black women born after 1948. Trends in these effects usually reflect risk factor trends, and thus, these declines are surprising because trends in most known or suspected risk factors would seem to predict an increasing breast cancer risk in this cohort.[19,20] The similarity in the shape of the recent birth cohort curves for white and black women indicates that major racial differences in risk factors for breast cancer are unlikely. Similarly, racial differences in trends in the most important breast cancer risk factors are unlikely in young women. In a recent case-control study,[22] known risk factors did not explain why breast cancer is more common in young black women than in young white women.

The second important pattern involves the decline of breast cancer mortality rates beginning in 1990 for white women aged 40 to 79 years. The age-period-cohort analysis indicates that these declines are characterized by decreasing calendar period effects, which for mortality data usually reflect changes in the effectiveness of medical interventions. These mortality declines were previously reported[6] to be preceded by declines in the incidence of regional disease in white women from the mid-1980s through 1992, and the present analysis indicates that these declines have continued through 1995. The declines in the incidence of regional disease have been attributed to stage shifts caused by the beneficial effects of mammography.[23,24] These shifts were

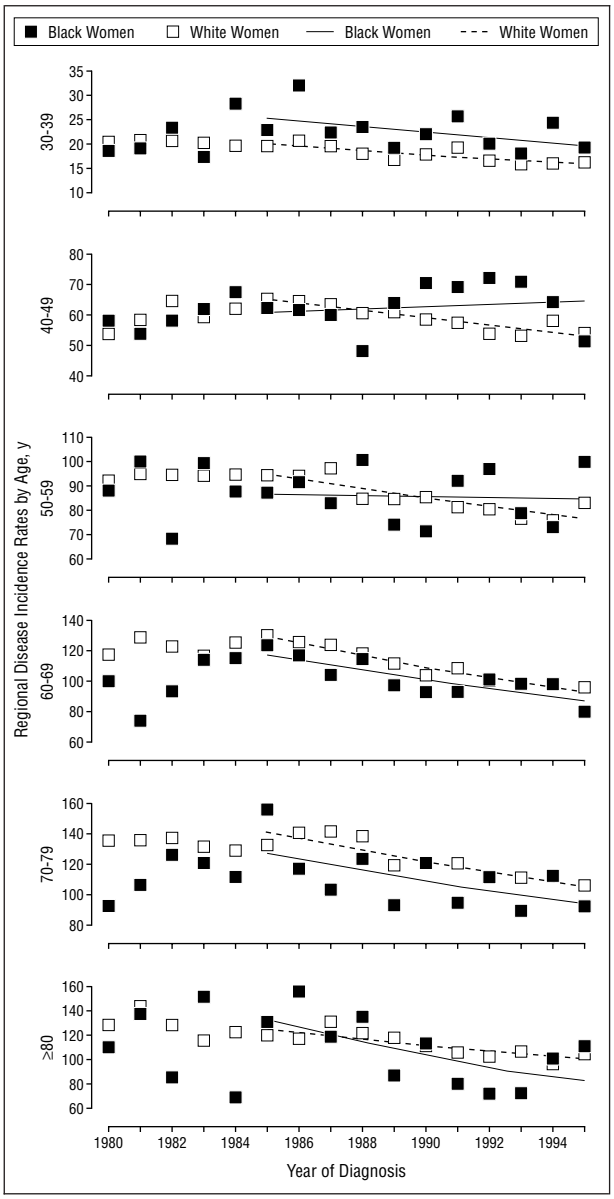

Figure 4. *Incidence of regional breast cancer disease by decades of age and for black women and white women in the United States.*

caused by mammography detecting cancers as localized disease that in later years, if left undetected, would have manifested as regional disease.[25-30] Furthermore, the mortality declines were preceded by increases in survival rates for regional disease from 1980 through 1989, and our analysis indicates that these increases have continued through 1992. These increases in regional disease survival have been attributed to the increased use of adjuvant therapy, such as chemotherapy, for premenopausal women and tamoxifen for postmenopausal women.[6] Thus, both mammography and treatment appear to play major roles in the decline in breast cancer mortality for white women aged 40 to 79 years.[6]

The third pattern is a leveling of breast cancer mortality rates in black women aged 40 to 69 years. Although the rates for black women in this age group have not declined significantly, they ceased increasing in the late 1980s. In the age-period-cohort analyses, this

Table 3. Annual Percentage Change in 3-Year Relative Survival Rates by Race, Age Group, and Stage of Disease at Diagnosis, 1980 through 1993*

Age Group, y	Race	Stage of Disease			
		All Stages	Localized	Regional	Distant
<50	B	0.15 ± 0.19	0.08 ± 0.20	0.50 ± 0.39	−0.62 ± 2.21
	W	0.55 ± 0.06†	0.35 ± 0.03†	0.65 ± 0.11†	2.11 ± 1.03
50-64	B	0.71 ± 0.18‡	0.43 ± 0.17‡	0.33 ± 0.38	−1.46 ± 2.45
	W	0.70 ± 0.07†	0.26 ± 0.05†	0.58 ± 0.11†	1.02 ± 0.57
≥65	B	1.27 ± 0.33‡	0.69 ± 0.27‡	0.34 ± 0.41	5.25 ± 3.01
	W	0.83 ± 0.09†	0.40 ± 0.08†	0.45 ± 0.10†	−0.40 ± 0.54
All ages	B	0.67 ± 0.14†	0.39 ± 0.16‡	0.41 ± 0.21	1.24 ± 1.45
	W	0.72 ± 0.06†	0.44 ± 0.04†	0.54 ± 0.07†	0.70 ± 0.22‡

*Data are given as slope ± SE.
†P<.001.
‡P<.05.

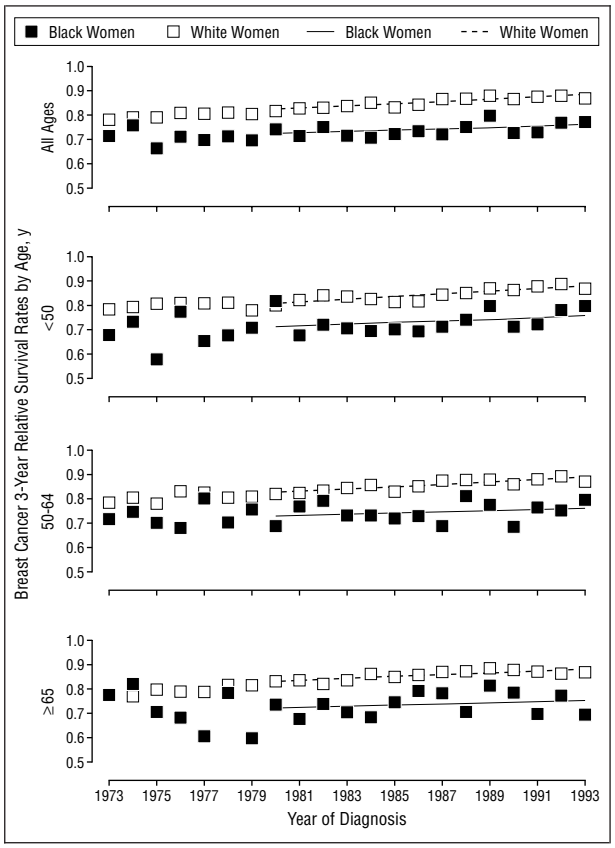

Figure 5. *Regional disease survival rates by decades of age and for black women and white women in the United States.*

moderation has been characterized as declines in the slope of the period effect curve in the mid-1980s and in 1990, implicating the beneficial effects of medical interventions. The effect of adjuvant therapy on these declines is unclear because survival rates for black women with regional disease did not increase significantly (Table 2). On the other hand, the incidence of regional disease from 1985 through 1995 declined significantly for black women aged 60 years and older. In particular, the stage-specific incidence patterns for 60- to 69-year-old black women resemble the pattern seen for white women, with increases in the incidence of localized disease beginning in the early 1980s and declines in the incidence of regional disease since the mid-1980s. These patterns have been associated with stage shifts caused by the early detection of breast cancer by mammography. Thus, mammography may have played a role in the recent moderation in mortality rates in older black women. In contrast, the moderations in these rates in black women aged 40 to 59 years do not appear to correlate with declines in their incidence rates for regional disease, although the variation in the incidence of regional disease in these age groups makes it difficult to determine trends.

The racial disparity in breast cancer mortality rates has grown despite indications that the percentage of black women from 1990 through 1994 having mammography is close to that of white women.[31] Although mammography use is comparable in black and white women, black women present with higher-stage disease, as evidenced by the higher incidence of distant disease. The beneficial effects of mammography require periodic screening,[24] and the frequency of screening may be more critical for black women than for white women. In a recent study[32] of factors affecting breast cancer stage at diagnosis in black and white women, it was shown that older black women who had annual mammography for 2 years had the same likelihood of late-stage disease as older white women who had this regimen of mammography. Black women who did not use mammography, however, were significantly more likely to have late-stage disease than white women who did not use mammography. These results reinforce the importance of outreach programs to promote regular mammographic screening for black women.

For health promotion to be successful for minority populations, the messages must address cultural barriers to early detection,[33] such as fatalistic folk beliefs about cancer. An investigation of socioeconomic and cultural factors on the racial differences in breast cancer stage at diagnosis showed that socioeconomic factors alone did not account for the racial differences; additional factors, such as cultural beliefs and attitudes, played a role. These results indicate that the underuse of early breast cancer detection procedures and cultural barriers to the use of these procedures need to be

addressed with health promotion activities that carry the message of the life-saving importance of periodic screening with mammography and clinical breast examinations.

Increased early detection alone cannot close the racial gap in breast cancer mortality rates. Early detection has to be followed by effective treatment. Effective treatment requires access to appropriate medical facilities. In a study[34] of breast cancer survival in the military, where equal access to health care is guaranteed for military personnel and their dependents, survival rates for black women were 33% higher than in the comparable black SEER population, whereas survival rates for white women receiving military health care were equal to those for the comparable white SEER population. These results suggest that increasing black women's access to health care may be an important factor in increasing their survival rates. This should be confirmed in other settings, with the use of designs like those in a recent study[35] that concluded that reduced access to health care could not explain higher prostate cancer mortality in black men.

Women with regional disease are candidates for adjuvant chemotherapy or tamoxifen therapy. Evidence from clinical trial data of the beneficial effects of adjuvant therapy is mounting. The use of tamoxifen for women who have positive estrogen receptor status and the use of chemotherapy in women with positive lymph nodes and in some with negative nodes have been recommended.[2-4] The first randomized clinical trials of chemotherapy as adjuvant therapy were begun in 1972 and 1973, with the initial finding of benefit reported in 1976.[36] The first randomized trials of the use of tamoxifen as adjuvant therapy were begun in 1977, with beneficial findings reported beginning in 1984.[37] As a consequence, the use of adjuvant therapy increased from the mid-1970s to the present, which is consistent with the significant increases in survival rates seen for white women having regional disease. Accordingly, the differential use of adjuvant therapy by race could lead to the racial differences in survival rates. Many studies[38-41] have shown, however, that the use of adjuvant therapy—either chemotherapy or hormonal therapy—does not vary significantly by race.

Differences in breast cancer survival between black and white women may be due to intrinsic differences in tumor biology. The distribution of tumor types differs demonstrably between the races—eg, black women have a lower percentage of estrogen receptor positive tumors.[42-46] In addition, results from the Black/White Cancer Survival Study[47] for breast cancer indicate that tumor pathological characteristics vary substantially between black and white women. After adjusting for age, stage at diagnosis, and metropolitan area, black women were significantly more likely to have high-grade nuclear atypia, high mitotic activity, grade 3 tumors, and more necrosis and significantly less likely to have well-defined tubular formation, marked fibrosis, and positive estrogen receptor status. These results were interpreted as evidence that black women have more aggressive tumors.

Despite evidence that racial differences exist in the distribution of tumor characteristics at diagnosis, evidence is increasing that, after adjustment for tumor characteristics and other prognostic variables, racial differences in survival are not significant.[48] In the Black/White Cancer Survival Study,[49] when tumor disease characteristics and variables for stage, treatment, comorbidities, and sociodemographic factors were incorporated into a model using breast cancer deaths as the outcome measure, differences between black and white women were no longer statistically significant. Furthermore, white and black women with the same type of disease who are given the same type of treatment have similar survival rates. In several studies of randomized trials of breast cancer in which treatments were assigned by strict protocol regardless of race, the overall survival of black women was less than that of white women. With adjustments, however, for the dose of chemotherapy, number of positive lymph nodes, estrogen-receptor status, and age, race was no longer of prognostic importance in a study[50] of patients with stage II breast cancer and in a study[51] of patients with early-stage breast cancer. In the investigation of breast cancer survival in the military, where access to health care is equal for military personnel and their dependents, marked racial differences remained after adjustments for stage and treatment.[34] The study, however, did not adjust for estrogen receptor status and obesity, 2 factors indicating a poor prognosis that are more prevalent in black women.

CONCLUSIONS

Most studies suggest that differences between black and white survival rates are not due to a differential response to treatment. That is, despite that black women with breast cancer tend to present with higher-stage disease, their tumors do not seem to follow a more aggressive course following diagnosis. Equal treatment appears to yield equal outcomes. Furthermore, published studies indicate that black and white women with the same extent of disease receive comparable treatment. This suggests that the problem is, at least in part, related to differential access to health care and that more programs are needed to remove barriers—both cultural and economic—that prevent black women from obtaining the regular health examinations that assure the early diagnosis of breast cancer.

Despite the evidence from treatment studies that breast cancer in black women is not inherently more aggressive than that in white women, there do appear to be racial differences in the natural history of breast cancer. Breast cancer incidence data from SEER show that black women younger than 40 years have higher rates than white women of the same age group.[52] Because no evidence exists that medical surveillance is greater in young black women than in young white women, this racial disparity in incidence must reflect a greater susceptibility to breast cancer in young black women. Further research is warranted to examine the higher incidence of breast cancer in young black women that does not appear to be due to racial differences in known risk factors.[22]

The increasing disparity between breast cancer mortality rates in black and white women is disturbing.

In 1980, breast cancer mortality for black and white women was nearly comparable. In 1990, the rates in black women were 16% higher than those in white women, and by 1995, the rates in black women were 29% higher than those in white women. The recent widening of the mortality disparity, which occurred during a period of unprecedented advances in breast cancer treatment, is a result of stable rates in black women and declining rates in white women. Only declines in breast cancer mortality in black women will close the gap. Age-period-cohort analyses indicate that improvements in medical interventions are responsible for much of the decreasing mortality in white women. The full range of health promotion and cancer control activities targeted at black women and their health care providers is required to close the widening racial gap in breast cancer mortality rates.

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REFERENCES

1. Brown ML, Kessler LG, Rueter FG. Is the supply of mammography machines outstripping need and demand? an economic analysis. *Ann Intern Med.* 1990;113: 547-552.
2. NIH Consensus Conference. Adjuvant therapy for breast cancer. *JAMA.* 1985; 254:3461-3463.
3. Early Breast Cancer Trialists' Collaborative Group. Effects of adjuvant tamoxifen and of cytotoxic therapy on mortality in early breast cancer. *N Engl J Med.* 1988; 319:1681-1692.
4. Early Breast Cancer Trialists' Collaborative Group. Systemic treatment of early breast cancer by hormonal, cytotoxic, or immune therapy: 133 randomised trials involving 31,000 recurrences and 24,000 deaths among 75,000 women. *Lancet.* 1992;339:1-15, 71-85.
5. Chu KC, Kramer BS, Smart CR. Analysis of the role of cancer prevention and control measures in reducing cancer mortality. *J Natl Cancer Inst.* 1991;83:1636-1643.
6. Chu KC, Tarone RE, Kessler LG, et al. Recent trends in US breast cancer incidence, survival and mortality rates. *J Natl Cancer Inst.* 1996;88:1571-1579.
7. Wingo PA, Ries LAG, Rosenberg HM, Miller DS, Edwards BK. Cancer incidence and mortality, 1973-1995: a report card for the U.S. *Cancer.* 1998;82:1197-1207.
8. Chevarley F, White E. Recent trends in breast cancer mortality among white and black US women. *Am J Public Health.* 1997;87:775-781.
9. Young JL Jr, Percy CL, Asire AJ, et al. Surveillance, Epidemiology, End Results: incidence and mortality data, 1973-1977. *Natl Cancer Inst Monogr.* 1981;57:1-187.
10. Horm JW, Asire AJ, Young JL, Pollack ES. *SEER Program: Cancer Incidence and Mortality in the United States, 1973-1981.* Bethesda, Md: National Cancer Institute, National Institutes of Health; 1985. NIH publication 85-1837.
11. Ederer F, Axtell LM, Cutler SJ. The relative survival rates: a statistical methodology. *Natl Cancer Inst Monogr.* 1961;6:101-121.
12. Beahrs OH, Henson DE, Hutter RVP, Kennedy BJ, eds (American Joint Committee of Cancer). *Manual for Staging of Cancer.* 4th ed. Philadelphia, Pa: JB Lippincott; 1992.
13. *International Classification of Diseases, Ninth Revision, Clinical Modification.* Washington, DC: Public Health Service, US Dept of Health and Human Services; 1980. DHHS publication PHS 80-1260.
14. Neter J, Wasserman W, Kutner MH. *Applied Linear Statistical Models.* 3rd ed. Homewood, Ill: Irwin Co; 1990.
15. Chu KC, Baker SG, Tarone RE. A method for identifying abrupt changes in US cancer mortality trends. *Cancer.* 1999;86:157-169.
16. Tarone RE, Chu KC. Implications of birth cohort patterns in interpreting trends in breast cancer rates. *J Natl Cancer Inst.* 1992;84:1402-1410.
17. Tarone RE, Chu KC. Evaluation of birth cohort patterns in population disease rates. *Am J Epidemiol.* 1996;143:85-91.
18. McCullagh P, Nelder JA. *Generalized Linear Models.* New York, NY: Chapman & Hall; 1989.
19. Tarone RE, Chu KC, Gaudette LA. Birth cohort and calendar period trends in breast cancer mortality in the United States and Canada. *J Natl Cancer Inst.* 1997;89: 251-256.
20. Chu KC, Tarone RE. Response - Re: Recent trends in U.S. breast cancer incidence, survival, and mortality rates [letter]. *J Natl Cancer Inst.* 1997;89:1810-1812.
21. Chu KC. Mortality rates by stage-at-diagnosis. *Semin Surg Oncol.* 1994;10:7-11.
22. Brinton LA, Benichou J, Gammon MD, Brogan DR, Coates R, Schoenberg JB. Ethnicity and variation in breast cancer incidence. *Int J Cancer.* 1997;73: 349-355.
23. Miller BA, Feuer EJ, Hankey BF. Breast cancer [letter]. *N Engl J Med.* 1992;327: 1756-1757.
24. Swanson GM, Ragheb NE, Lin CS, et al. Breast cancer among black and white women in the 1980s. *Cancer.* 1993;72:788-798.
25. White E, Lee CY, Kristal AR. Evaluation of the increase in breast cancer incidence in relation to mammography use. *J Natl Cancer Inst.* 1990;82:1546-1552.
26. Liff JM, Sung JFC, Chow WH, Greenberg RS, Flanders WD. Does increased detection account for the rising incidence of breast cancer? *Am J Public Health.* 1991;81:462-465.
27. Lantz PM, Remington PL, Newcomb PA. Mammography screening and increased incidence of breast cancer in Wisconsin. *J Natl Cancer Inst.* 1991;83: 1540-1546.
28. Miller BA, Feuer EJ, Hankey BF. The increasing incidence of breast cancer since 1982: relevance of early detection. *Cancer Causes Control.* 1991;2:67-74.
29. Feuer EJ, Wun ML. How much of the recent rise in breast cancer incidence can be explained by increases in mammography utilization: a dynamic population model approach. *Am J Epidemiol.* 1992;136:1423-1436.
30. Miller BA, Feuer EJ, Hankey BF. Recent incidence trends for breast cancer in women and the relevance of early detection: an update. *CA Cancer J Clin.* 1993;43:27-41.
31. National Center for Health Statistics. *Health, United States, 1998, With Socioeconomic Status and Health Chartbook.* Hyattsville, Md: National Center for Health Statistics; 1998. DHHS Publication (PHS) 98-1232.
32. McCarthy EP, Burns RB, Coughlin SS, et al. Mammography use helps to explain difference in breast cancer stage at diagnosis between older black and white women. *Ann Intern Med.* 1998;128:729-735.
33. Lannin DR, Mathews HF, Michell J, Swanson MS, Swanson FH, Edwards MS. Influence of socioeconomic and cultural factors on racial differences in late-stage presentation of breast cancer. *JAMA.* 1998;279:1801-1807.
34. Wojcik BE, Spinks MK, Optenberg SA. Breast carcinoma survival analysis for African American and white women in an equal-access health care system. *Cancer.* 1998;82:1310-1318.
35. Robbins AS, Whittemore AS, Van Den Eeden SK. Race, prostate cancer survival, and membership in a large health maintenance organization. *J Natl Cancer Inst.* 1998;90:986-990.
36. Bonadonna G, Brusamolino E, Valagussa P, et al. Combination chemotherapy as an adjuvant treatment in operable breast cancer. *N Engl J Med.* 1976;294: 405-410.
37. Review of mortality results in randomized trials in early breast cancer. *Lancet.* 1984;2:1205.
38. Ownby HE, Frederick J, Russo J, et al. Racial differences in breast cancer patients. *J Natl Cancer Inst.* 1985;75:55-60.
39. Elledge RM, Clark GM, Chamness GC, Osborne CK. Tumor biologic factors and breast cancer prognosis among white, Hispanic, and black women in the United States. *J Natl Cancer Inst.* 1994;86:705-712.
40. Muss HB, Hunter CP, Wesley M, et al. Treatment plans for black and white women with stage II node-positive breast cancer: the National Cancer Institute Black/White Cancer Survival Study experience. *Cancer.* 1992;70:2460-2467.
41. Diehr P, Yergan J, Chu J, et al. Treatment modality and quality differences for black and white breast-cancer patients treated in community hospitals. *Med Care.* 1989;27:942-958.
42. Collings JR, Levin J, Savage N. Racial differences in oestrogen receptor and peroxidase status of human breast cancer tissue. *S Afr Med J.* 1980;57:444-446.
43. Lesser ML, Rosen PP, Senie RT, Duthie K, Menendez-Botet C, Schwartz MK. Estrogen and progesterone receptors in breast carcinoma: correlations with epidemiology and pathology. *Cancer.* 1981;48:299-309.
44. Mohla S, Sampson CC, Khan T, Enterline JP, Leffall L Jr, White JE. Estrogen and progesterone receptors in breast cancer in Black Americans: correlation of receptor data with tumor differentiation. *Cancer.* 1982;50:552-559.
45. Hulka BS, Chambless LE, Wilkinson WE, Deubner DC, McCarty KS Sr, McCarty KS Jr. Hormonal and personal effects on estrogen receptors in breast cancer. *Am J Epidemiol.* 1984;119:692-704.
46. Natarajan N, Nemoto T, Mettlin C, Murphy GP. Race-related differences in breast cancer patients: results of the 1982 national survey of breast cancer by the American College of Surgeons. *Cancer.* 1985;56:1704-1709.
47. Chen VW, Correa P, Kurman RJ, et al. Histological characteristics of breast carcinoma in blacks and whites. *Cancer Epidemiol Biomarkers Prev.* 1994;3:127-135.
48. Roach M III, Alexander M. The prognostic significance of race and survival for breast cancer: a model for assessing the reliability of reported survival differences. *J Natl Med Assoc.* 1995;87:214-219.
49. Eley JW, Hill HA, Chen VW, et al. Racial differences in survival from breast cancer: results of the National Cancer Institute Black/White Cancer Survival Study. *JAMA.* 1994;272:947-954.
50. Roach M III, Cirrincione C, Budman D, et al. Race and survival for breast cancer: based on Cancer and Leukemia Group B trial 8541. *Cancer J Sci Am.* 1997;3: 107-112.
51. Dignam JJ, Redmond CK, Fisher B, Costantino JP, Edwards BK. Prognosis among African-American women and white women with lymph node negative breast carcinoma: findings from two randomized clinical trials of the National Surgical Adjuvant Breast and Bowel Project (NSABP). *Cancer.* 1997;80:80-90.
52. Ries LAG, Kosary CL, Hankey BF, Miller BA, Edwards BK, eds. *SEER Cancer Statistics Review, 1973-1995.* Bethesda, Md: National Cancer Institute; 1998.